

POSTGRADUATE TRAINING FELLOWSHIPS 2011-2012

# Snowpack assessment and avalanche forecasting tools

16<sup>TH</sup> PROJECT

TECHNIQUES OF SNOWPACK ASSESSMENT AND AVALANCHES  
OPERATIONAL WEATHER PREDICTION TOOLS  
VALIDATION OF SNOWPACK ASSESSMENT SIMULATION MODELS

VÍCTOR MANUEL PALACIOS FERMOSO

Tutor: GERARDO SANZ



AEMet territorial office in Aragón (Zaragoza)



# AVALANCHE PREDICTION IMPROVEMENT

## Fellowship activities

Nivology and avalanches training

Collaboration on:

- improvement of available information for operative forecast
- development and validation of snowpack simulation model

Monitoring and checking of avalanches operative prediction tools

Analysis of observation data quality



## TRAINING

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Collaboration on:

- improvement of available information for operative forecast
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Monitoring and check of operational  
operative prediction tools

Analysis of observation data quality

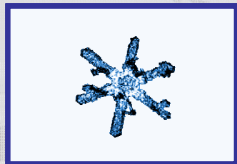
1. Avalanches and mountain theoretical training; information, bibliography and Aemet territorial office in Aragón staff.
2. Practical training: avalanche and meteorological observers course (Benasque, January 31st – February 3rd 2012).



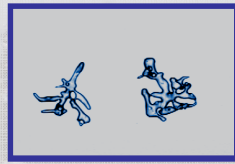
## TRAINING

### 1. Avalanche and mountain theoretical training; information, bibliography and Aemet territorial office in Aragón staff.

- Snow formation and evolution . Grain types*



*Fresh snow*



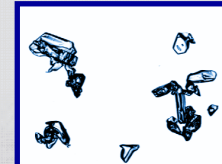
*Fragmented part.*



*Graupel*



*Surface hoar*

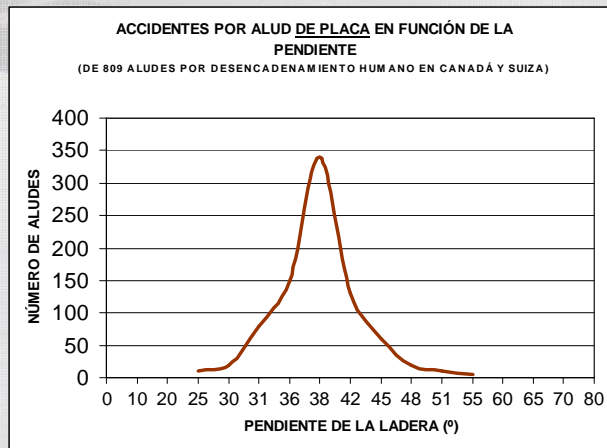


*Faceted crystals*



*Deep hoar  
Goblets*

- Evaluation of avalanche release danger*



Índice de peligro	Estabilidad del manto nivoso	Probabilidad de desencadenamiento
<b>5. MUY FUERTE</b>	Inestabilidad generalizada del manto nivoso.	Son esperables aludes de tamaño grande, desencadenados espontáneamente, en numerosas laderas, incluyendo zonas con pendientes poco inclinadas.
<b>4. FUERTE</b>	En la mayoría de las pendientes (**) suficientemente propicias a los aludes, el manto nivoso está débilmente estabilizado.	Se pueden desencadenar aludes, incluso por sobrecargas débiles en la mayoría de las pendientes suficientemente propicias a los mismos. En ciertas situaciones, son posibles numerosas salidas espontáneas de aludes de dimensiones medias y a veces grandes.
<b>3. NOTABLE</b>	En numerosas pendientes (**) suficientemente propicias, el manto sólo está moderada o débilmente estabilizado.	Se pueden desencadenar aludes, incluso por sobrecargas débiles y en numerosas pendientes cuyas características se describen habitualmente en el boletín. En ciertas situaciones son posibles algunas salidas espontáneas de aludes de dimensiones medias y a veces grandes.
<b>2. LIMITADO</b>	En algunas pendientes (**) suficientemente propicias a los aludes, el manto sólo está moderadamente estabilizado. En el resto, está bien estabilizado.	Se pueden desencadenar aludes sobre todo por sobrecargas fuertes y en algunas pendientes cuyas características se describen normalmente en el boletín. No se esperan salidas espontáneas de aludes de gran amplitud.
<b>1. DÉBIL</b>	En la mayoría de las pendientes el manto nivoso está bien estabilizado.	Excepcionalmente, sólo pueden desencadenarse aludes en algunas pendientes muy propicias (*) y, sobre todo a causa de fuertes sobrecargas. De forma natural sólo pueden desencadenarse coladas o pequeños aludes.




# TRAINING


- **Snow measurements: data and its format**

- **Nivomet reports - Nivomet Key:** 219// 20000 10220 29040 70000 ....

- **Snow profile**

- **Stability test**

		ESTACIÓN: FORMIGAL GAC LUGAR DE MEDIDA: M. MU. UTAR FECHA: 16-2-12 HORA: 10:30 h OBSERVADOR: J.C. Echeverría / J. A. B.	ALTURA: 1.900 m. DIRECCIÓN: V.E. TEMPERATURA: -24°C TIEMPO PRESENTE: NUBOSCA NÚMERO DE TUBOS: 2	SONDEO POR GOLPEO NÚMERO: 2											
Resistencia al golpe Peso móvil (kg) Número de golpes Altura de caída (cm)		$R = \frac{P \times n \times h}{d} + q + P$		d: Hundimiento por n golpes (cm) q: Número de tubos x: Hundimiento total de la sonda (cm) H: Altura desde el suelo (cm)											
q	p	n	h	x	d	R	H	q	p	n	h	x	d	R	H
1	0	0	3	3	1	109									
1	1	0	0	14	1	2	106								
1	1	4	5	19	5	6	95								
1	1	10	4	24	5	40	90								
1	1	1	4	5	33	9	85								
1	1	1	4	5	36	3	76								
1	1	1	10	10	40	4	73								
1	1	1	10	20	48	8	69								
1	1	1	2	20	53	5	61								
1	1	1	2	15	56	3	56								
1	1	1	1	14	60	4	53								
1	1	1	1	1	30	65	5	49							
1	1	1	1	3	20	72	7	44							
1	1	1	5	15	38	6	39								
1	1	1	10	15	34	6	31								
1	1	1	10	20	39	4	25								
1	1	1	12	40	43	10	21								
1	1	1	3	15	40	9	11								
1	1	1	3	15	109	2	22								

		ESTACIÓN: FORMIGAL GAC LUGAR DE OBSERVACIÓN: MINUTAR ALTURA: 1.900 m. DIRECCIÓN: V.E. OBSERVADOR: J.C. Echeverría / J. A. B.	PERFIL ESTRATIGRÁFICO N° 8 FECHA: 16-2-12 HORA LOCAL: 10:30 h TEMPERATURA DEL AIRE: -24°C									
TEMPERATURA DE LA NIEVE	H	F <sub>1</sub>	F <sub>2</sub>	Dm	d	u	Des	CAL	Cu	C	(h)	Si se da en cm
cm	cm	cm	cm	cm	cm	cm	Kg/m²	%	%	%	cm	
Escribir sobre las líneas punteadas												
109	0	109										
100	4	95										
90	4	77										
80	4	77										
70	4	60										
60	4	58										
50	4	58										
40	4	50										
30	4	50										
20	4	43										
10	4	35										
0	4	0										



Víctor Manuel Palacios Fermoso



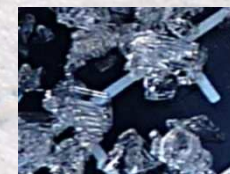
AEMet territorial office in Aragón (Zaragoza)



## TRAINING

### 2. Practical training

- Avalanche and meteorological observers course (Benasque, January 31st – February 3rd 2012).





## AVALANCH OPERATIVE PREDICTION TOOLS

### Fellowship activities

Nivology and avalanches training

Collaboration on:

- improvement of available information for operative forecast
- development and validation of snowpack simulation model

Monitoring and checking of avalanche operative prediction tools

Analysis of observation data quality

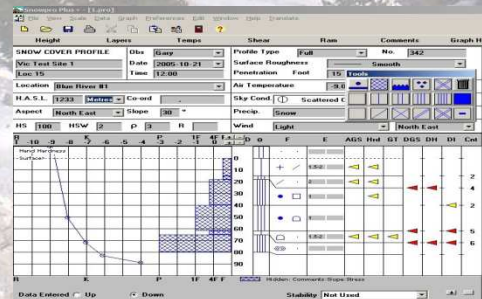
1. Available software for the management and running of snow observation data in the operative environment.
2. Evaluation of use possibilities and adaptation to Aemet needs.



# AVALANCH OPERATIVE PREDICTION TOOLS

## 1. Available software for the management and running of snow observation data in the operative environment

- Assessment of software possibilities of generating standard format data.
- Warehousing and exchange formats for snowpack measurements data: snow pit and stability test.
- Graphical representation of snow profiles



**Snowpro Plus+**

- Canada
- Paid
- xml format

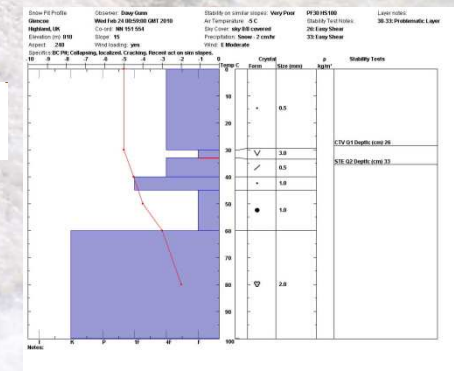


Gestione Dati  
Nivometeorologici  
**YETI**  
ver. 3.3.5

- Italy
- Free software
- mdb format

**SNOW PILOT**

- EE.UU.
- Free software
- xlm and gml format



Víctor Manuel Palacios Feroso

**AEMet**  
Agencia Estatal de Meteorología

AEMet territorial office in Aragón (Zaragoza)



## AVALANCH OPERATIVE PREDICTION TOOLS

## 2. Evaluation of use possibilities and adaptation to Aemet needs

**Software YETI ( AINEVA –Associazione Interregionale neve e valanghe–)**

The screenshot displays the Yefiver 3.3.5 application window. The title bar reads "Yefiver 3.3.5". Below it is a toolbar with icons for Mod.1, Mod.2/3, Mod.6, Info, and Exit. The main menu bar includes "Archivio Mod.1 Regione Friuli Venezia Giulia" and "Stagione Invernale 2011/2012". A secondary toolbar contains icons for Station selection, Date range (from 01/10 to 30/09), Period selection, Print, and Double entries. The central area is a large grid for data entry. The columns are labeled: Data, Ora, Staz., w/w, N, V, V/Q, Ta, Tm, Tn, HS, HN, rho, Th, TH, PR, CS, S, B, L1, L2, L3, L4, L5, L6, L7, L8, and Testo. The rows are numbered from 1 to 100. At the bottom, there are buttons for Import, Export, Validation of data, Stampa (Print), and Chiusura (Close).



# AVALANCH OPERATIVE PREDICTION TOOLS

Yeti ver. 3.3.5

Mod.1 Mod.2/3 Mod.6 Info Exit

Archivo Mod.2/3 Regione Friuli Venezia Giulia Stagione Invernale 2010/ 2011

33%

Esposizione:		Pendenza:		Precipitazioni:	
Coordinate:		Rilevatore:		Vento:	
T(°C)	R(N)			H	Θ
-30	2000	-25	1500	-20	1000
-18	900	-16	800	-14	700
-12	600	-10	500	-8	400
-6	300	-4	200	-2	100

Diff. dimens. grani  
Dimensione grani  
Diff. durezza  
Durezza  
Forma dei grani  
Profondità

Ta °C

Superficie 0 cm

G L M 1D 4D P

# YETI



Prova Penetrometrica

q	P	n	h	X	Δ	R
10	0	0	0	0	0	0

Ricalcola D e R Annulla OK

Prova Stratigrafica

Da	A	th	OO	F	O	F	E	O	E	R	Commento	SWE

Annulla OK Densità Media 100,00 Totale SWE

Víctor Manuel Palacios Feroso



AEMet territorial office in Aragón (Zaragoza)



# AVALANCH OPERATIVE PREDICTION TOOLS

Yeti ver. 3.3.5

Mod.1 Mod.2/3 Mod.6 Info

Archivio Mod. 6 Regione Friuli Venezia Giulia Stagione Invernale 2011/ 2012

Area di Osservazione: TUTTE Periodo Dal: 01/10 Al: 30/09 Stampa Modulo Vuoto

Area	Località	Quota	Data	Ora	Rilevatore	Nr	Area Vinc.
						0	

Neve al Suolo e Superfic./Pioggia/Ultima Nevicata Cop. Nevosa/ Strato Superf./ Attività Eolica Attività Sciistica/Valanghe Spontanee/ Danni

Neve al Suolo cm.

Quota (m.s.l.m.)	N	E	S	W
a 1500 m				
a 2000 m				

Neve a debole coesione in superficie cm.

Quota (m.s.l.m.)	N	E	S	W
a 1500 m				
a 2000 m				

Pioggia

il giorno \_\_\_\_\_

fino alla quota di \_\_\_\_\_

Ultima Nevicata (999 tracce)

Quota (m.s.l.m.) Esposiz. cm

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Note \_\_\_\_\_

Neve al Suolo e Superfic./Pioggia/Ultima Nevicata Cop. Nevosa/ Strato Superf./ Attività Eolica Attività Sciistica/Valanghe Spontanee/ Danni

Valanghe Spontanee

Assenti ☐ 1 giorno ☐ 3 giorni ☐ + di 3 giorni ☐ Non Rilevabili ☐

	N	E	S	W
< 1500				
1500-2000				
2000-2500				
> 2500				

1- piccole valanghe spontanee e piccoli scrosci  
2- valanghe spontanee di media grandezza  
3- molte valanghe di media grandezza  
4- singole grandi valanghe  
5- numerose grandi valanghe  
6- valanghe di superficie  
7- valanghe di fondo  
8- percorsi delle valanghe abituali  
9- percorsi delle valanghe eccezionali

Periodo del distacco Non accettabile Le valanghe si sono verificate nei giorni \_\_\_\_\_

Danni ☐ Persone ☐ Abitazioni civili ☐ Strade ☐ Impianti di risalita  
☐ Piste da sci ☐ Bosco ☐ Altro

Note \_\_\_\_\_

Cancella Nuovo Stampa Import Export Chiudi

Copertura Nevosa

Esposizione ☐ ☐

Assente fino a (m.s.l.m.) ☐

Discontinua fino a quota ☐

Continua oltre i (m.s.l.m.) ☐

Strato Superficiale

Quota (m.s.l.m.)	Tipo	Quota (m.s.l.m.)	Tipo
Oltre i		Oltre i	
Da	a	Da	a
Fino a		Fino a	

Attività eolica in quota

Non rilevabile ☐

Assente ☐

Intensità

Debole ☐

Moderata ☐

Forte ☐

Data \_\_\_\_\_

nessuno ☐

Esposizione accumulata

N	E	S	W

Cancella Nuovo Stampa Import Export Chiudi

A: neve a debole coesione asciutta  
B: neve a debole coesione bagnata  
C: crosta da fusione/rigelo portanti  
D: crosta da fusione/rigelo non portanti  
E: ampie zone erose/o senza neve  
F: crosta da vento  
G: accumuli  
H: brina di superficie

YETI





## OBSERVATION DATA

### Fellowship activities

Nivology training

Collaboration on:

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Monitoring and checking of avalanche operative prediction tools

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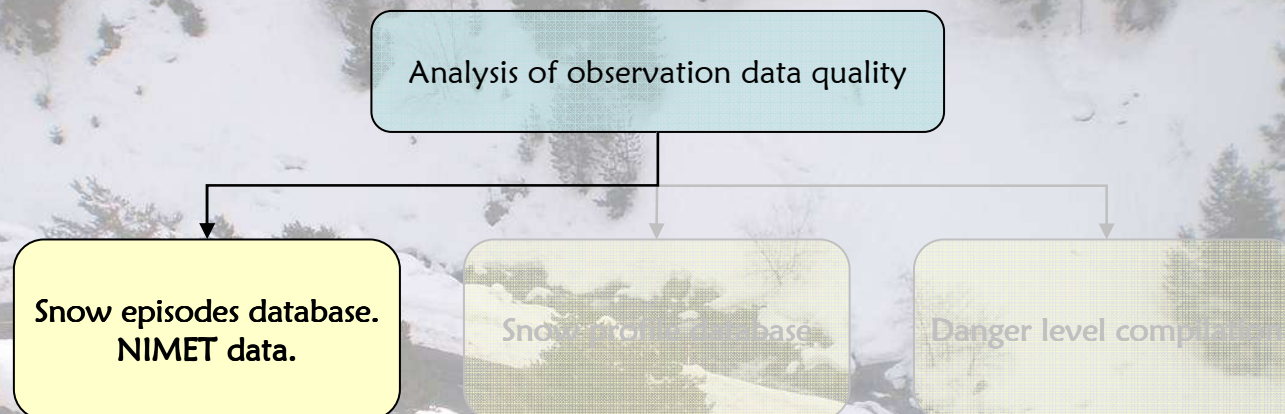
Snow episodes database.  
NIMET data.

Snow profile database

Danger level compilation



## OBSERVATION DATA



1. Monitoring of the most important snow episodes in the Aragonese and Navarre Pyrenees. Creation of database.
2. Revision and checking of the NIMET reports data provided by the mountain shelters and ski resorts.



## OBSERVATION DATA

### 1. Monitoring of the most important snow episodes in the Aragonese and Navarre Pyrenees.

- Creation of a relevant snow episodes database to:
  - making seasonal reports editing easier.
  - providing study cases and patterns identification by technical staff.
- Prediction support as snow and meteorological episodes database to providing information about the snowpack evolution from the beginning of the season.
- Future expansion to the mountain areas with snow bulletin.

Microsoft Access - [Episodios de relevancia nivológica : Tabla]

Archivo Edición Ver Insertar Formato Registros Herramientas Ventana 2

Escriba una pregunta

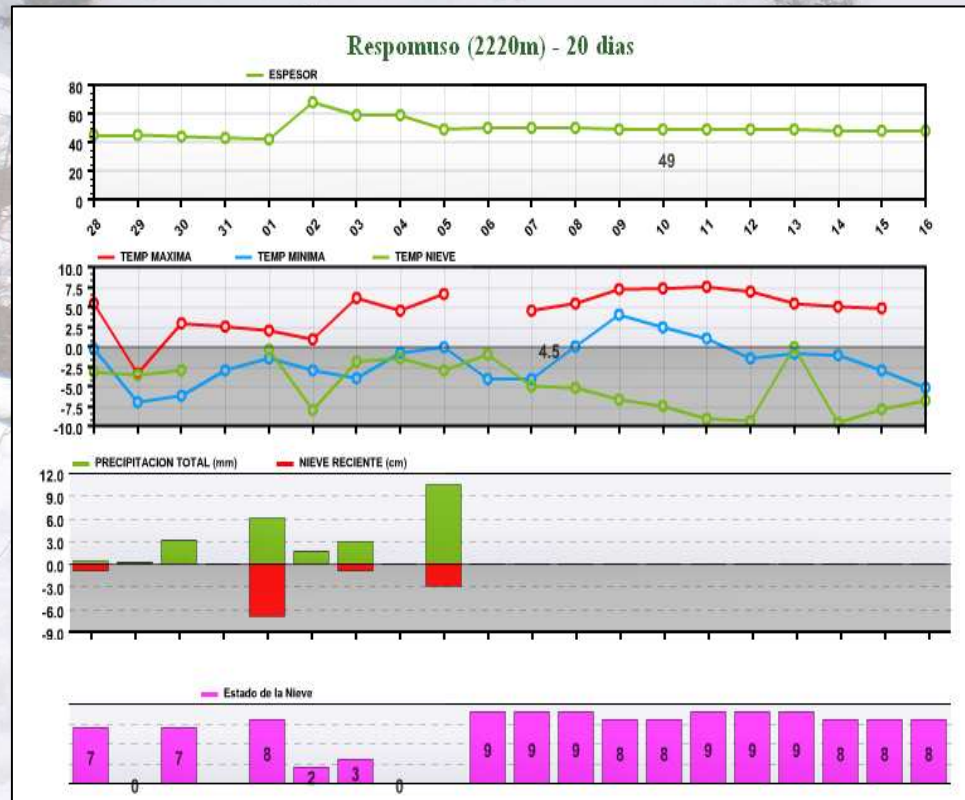
Fecha	Zona	Duración	Evento 1	Evento 2	Evento 3	Cota	Lluvia	Viento	Nieve 1000m	Nieve 2000m	Nieve 3000m	Riesgo parte	Riesgo ref	Aludes ref
01/11/2011	6 Todas	1	Nieve			2000								
02/11/2011	1 Navarra	7	Lluvia	Viento		2200-1900	75	N Fuerte-Muy Fuerte						PROFUNDA BOI
02/11/2011	2 Jacetania	7	Lluvia			2200-1900	210	N Fuerte-Muy Fuerte						PROFUNDA BOI
02/11/2011	3 Gallego	7	Nieve	Lluvia		2200-1900	180	N Fuerte- Muy Fuerte		95		5	5	PROFUNDA BOI
02/11/2011	4 Sobrarbe	7	Nieve	Lluvia		2200-1900	310	N Fuerte-Muy Fuerte		25			1	PROFUNDA BOI
02/11/2011	5 Ésera	7	Nieve	Lluvia		2200-1900	160	N Fuerte-Muy Fuerte		7			1	PROFUNDA BOI
10/11/2011	6 Todas	2	Lluvia			2200	10-15	S Flojo		10-40			2	POCO NUBOSO
14/11/2011	2 Jacetania	3	Lluvia			2100	15	S-E Moderado						SUPERFICIE: TF
14/11/2011	3 Gallego	3	Lluvia			2100	20	S-E Moderado		35			1	SUPERFICIE: TF
14/11/2011	4 Sobrarbe	3	Lluvia			2100	35	S-E Moderado						SUPERFICIE: TF
15/11/2011	1 Navarra	2	Lluvia			2100	5	S-E Flojo						LA DEPRESION
15/11/2011	5 Ésera	2	Lluvia			2100	15	S-E Flojo		15				LA DEPRESION
19/11/2011	2 Jacetania	4	Lluvia			2200	5	S-E Flojo-Moderado						POTENTE ANTIC
19/11/2011	3 Gallego	4	Lluvia	Nieve		2200	5-10	S-E Flojo-Moderado		20			1	POTENTE ANTIC
19/11/2011	4 Sobrarbe	4	Lluvia	Nieve		2200	10	S-E Flojo-Moderado		5-10			1	POTENTE ANTIC
19/11/2011	5 Ésera	4	Lluvia	Nieve		2200	10	S-E Flojo-Moderado		15-20			1	POTENTE ANTIC
02/12/2011	1 Navarra	6	Lluvia	Nieve		1400	15???	VAR Flojo				1		NIVELES ALTOS
02/12/2011	2 Jacetania	6	Nieve	Lluvia		1400	5-10???	VAR Flojo				1		NIVELES ALTOS
02/12/2011	3 Gallego	6	Nieve	Lluvia		1400	10???	VAR Flojo		5		1	1	NIVELES ALTOS
12/12/2011	1 Navarra	2	Nieve	Lluvia		1600-1800	10	N moderado				1		FRENTE FRIO E
16/12/2011	1 Navarra	7	Nieve	Lluvia		800-1800	150	N moderado		45		3-2		
16/12/2011	2 Jacetania	7	Nieve	Lluvia		700-2000	170	N-O moderado-fuerte		50		4-2	4-2	
16/12/2011	3 Gallego	7	Nieve	Lluvia		700-2000	70	N-O moderado-fuerte		130		4-2	4-3	



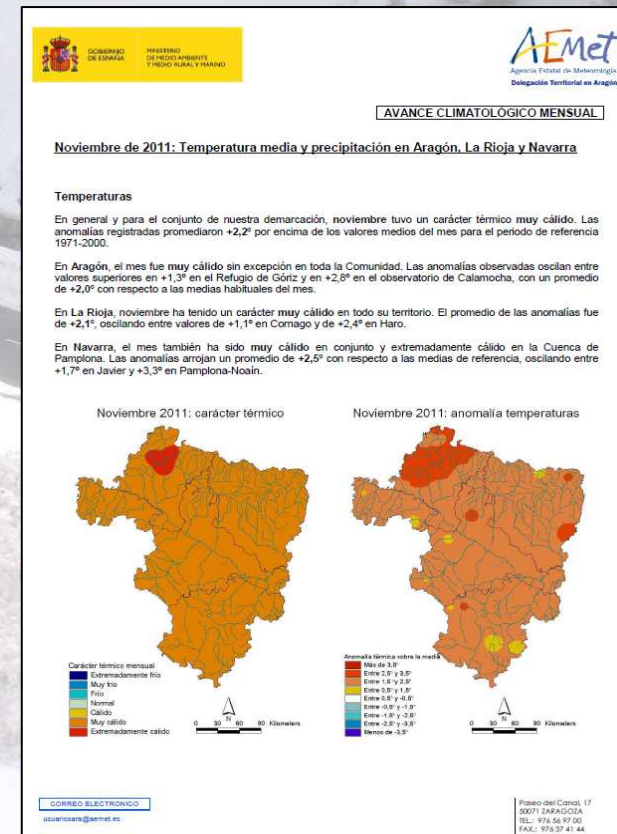
## OBSERVATION DATA

### 2. Revision and checking of the NIMET reports data provided by the mountain shelters and ski resorts.

- Variables evolution graphs: snowpack assessment

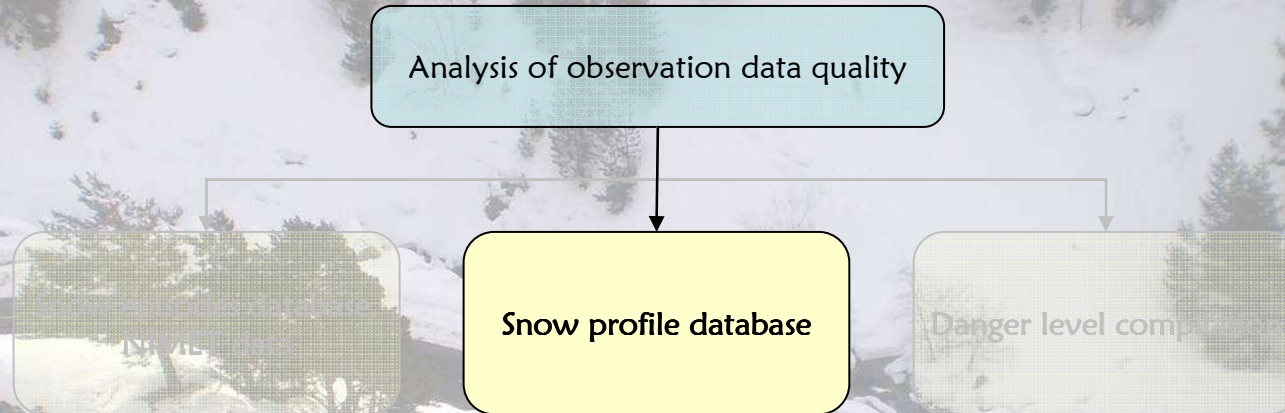


- Monthly and annual climatologic summaries





## OBSERVATION DATA

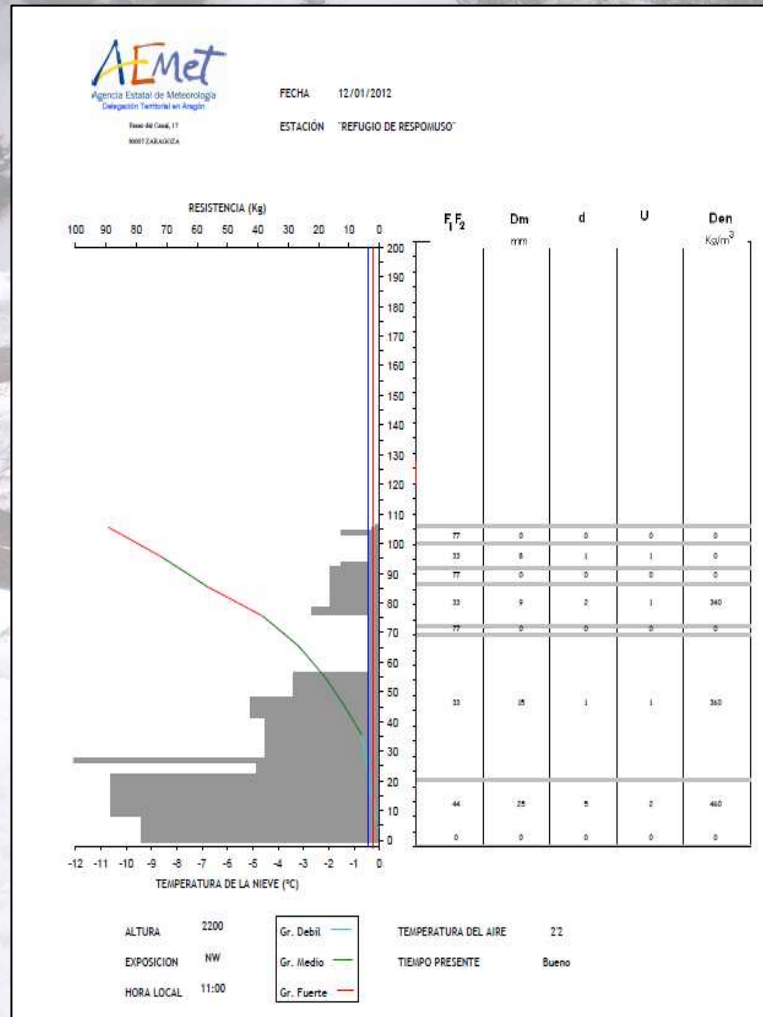


1. Generation of the stratigraphic profile from the snow pits of the current season.
2. Study of the data from the snow profiles of this season and previous ones.
3. Collaboration with the Pyrenaic Institute of Ecology of the University of Zaragoza (planned).



## OBSERVATION DATA

### 1. Generation of the stratigraphic profile from the snow pits of the current season



- Weekly reception of the snow pits made in the mountain shelters and ski resorts
- Generation of the stratigraphic profile in an Excel spreadsheet
- Participation in the study of the snowpack stability as support in the forecast of avalanches danger level

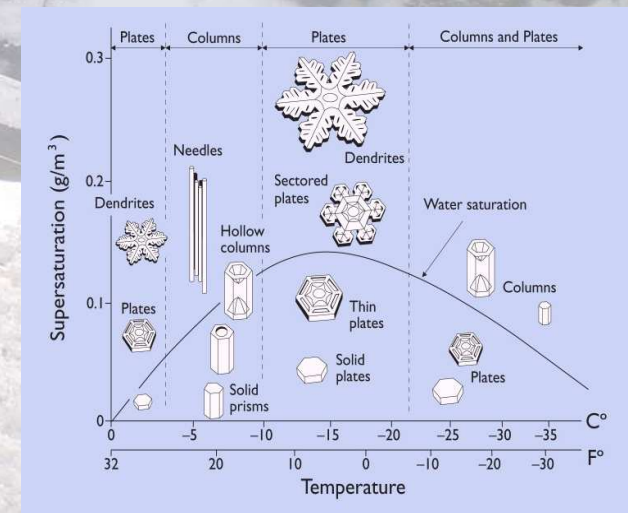


## OBSERVATION DATA

### 2. Study of the data from the snow profiles of this season and previous ones.

- Warehousing in a database. Future integration in the national database.
- Study, applied to the Pyrenees, of the relationships between the analyzed variables and the crystal typology of the snowpack: *climatology of the snowpack profiles*.

Sondeo	H(T)	T	H	FF	Dm	d	U	Den
CDP100306	0	-1,1						
CDP100311	218	-5	218 33		1	2	1	400
CDP100311	210	-6,2	200 77			4		
CDP100311	200	-9,5	197 33		2	4	1	400
CDP100311	190	-9,3	190 34		1	4	1	380
CDP100311	180	-8,8	172 33		0,8	5	1	
CDP100311	170	-7,7	169 7			4		
CDP100311	160	-6,7	161 33		0,8	3	1	360
CDP100311	150	-5,8	149 77			4		
CDP100311	140	-4,8	145 33		0,8	3	1	360
CDP100311	130	-3,8	135 33		0,8	3	1	380
CDP100311	120	-2,8	95 66		2	3	1	420
CDP100311	110	-2,7	80 66		2	3	4	420
CDP100311	100	-2,1	60 7			3	1	380
CDP100311	90	-1,9	55 46		1	2	1	380
CDP100311	80	-1,6	30 46		1	2	1	420
CDP100311	70	-1,5						
CDP100311	60	-1,4						
CDP100311	50	-1,2						
CDP100311	40	-1,1						
CDP100311	30	-1,1						
CDP100311	20	-0,8						
CDP100311	10	-0,5						
CDP100311	0							
CDP100326	160	0	160 99			2	3	360
CDP100326	150	0	152 66		3	1	2	520
CDP100326	140	0	137 64		2	2		520
CDP100326	130	0	130 66		1,5	1	2	440
CDP100326	120	0	115 7			2		
CDP100326	110	0	110 3		1	1	2	420
CDP100326	100	0	97 7			2		
CDP100326	90	0	92 3		1	1	2	420
CDP100326	80	0	70 7			2		
CDP100326	70	0	67 6		2	1	2	380
CDP100326	60	0	50 7			2		
CDP100326	50	0	45 64		1,5	1	2	480
CDP100326	40	0						
CDP100326	30	0						
CDP100326	20	0						
CDP100326	10	0						
CDP100326	0	0						

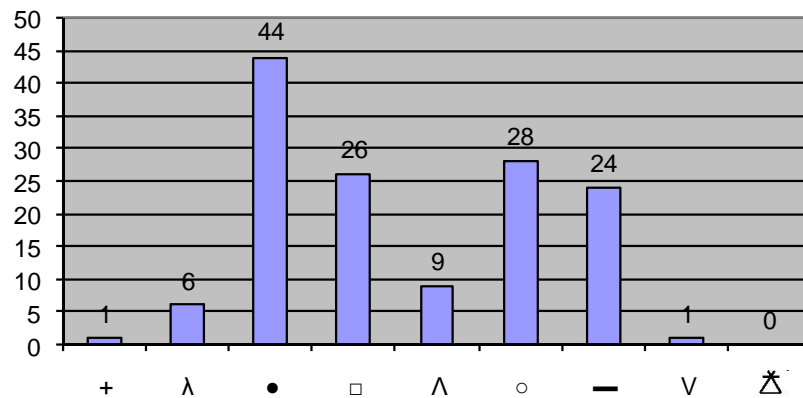




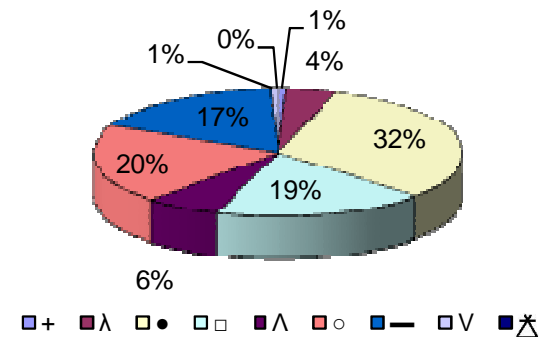
## OBSERVATION DATA

- Appearance frequency of grain types in the snowpack. Distribution by months, slope orientation, steepness and altitude levels.  
Climatology of the temperature, resistance and density profiles.

Number of observations of crystal grain type in the Aragonese Pyrenees profiles (current season)

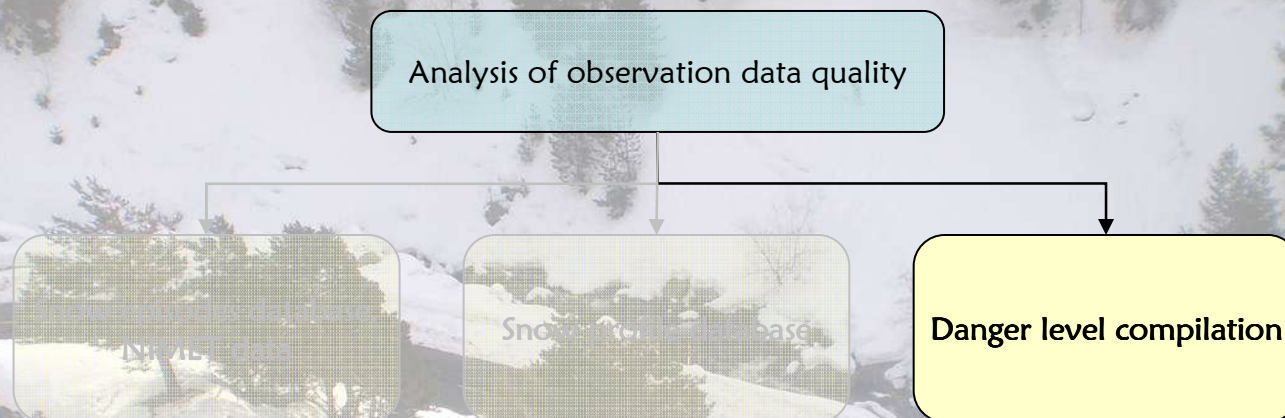


Proportion of snowpack crystal grain type in the Aragonese and Navarre Pyrenees (current season)





## OBSERVATION DATA



1. Compilation and analysis of the issued danger levels for the Aragonese and Navarre Pyrenees in the period 2000–2010.
2. Checking of the danger levels issued in the last season and the current one.



## OBSERVATION DATA

### 1. Compilation and analysis of the issued danger levels for the Aragonese and Navarre Pyrenees in the period 2000–2010.

- Database “Nimet”, which was running until 2007.
- Occurrence statistics since 2000.
- Possible participation in the program of issued danger levels comparison between neighbouring countries, which was proposed by Mètèo-France in the 16th Meeting of the EAWS (September 2011)

The screenshot displays the NIMET application interface. The main window is titled "NIMET" and contains a login form with fields for "usuario:" and "password:". Below the login form, there is a menu with options: "Archivo", "Especial", and "Utilidades". The "Especial" menu is selected, showing a "RESUMEN DE DATOS DE PARTES" (Summary of Data by Part) screen. This screen includes a description: "Obtiene un informe previamente definido, sin valor climatológico, con el resumen de datos para cada mes." and fields for "título del informe...", "indicativo sinoptico...", "año...", "mes...", "hora...", and "resumen s/n:". The "año" field is set to "2009" and "mes" to "12". The "hora" field is set to "08". The "resumen s/n" field is set to "S". The "ESC=abandona" button is visible at the bottom of the menu.

The bottom right of the screenshot shows a data table with columns for date, time, and various numerical values. The table is titled "RESUMEN DE DATOS DE LA ESTACION PANTICOSA 'REF. CASA PIEDRA' < 08922 >, AÑO 2". The table contains data for the year 2009, with columns for date, time, and various numerical values.

FECHA	HORA	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2009-12-05	00	08922	21597	49920	10046	76076	84010	333	10058	21																
2009-12-05	08	08922	21997	00000	11051	70000	80000	333	10057	21																
2009-12-05	08	08922	21997	00000	11078	70000	80000	333	10036	21																
2009-12-05	08	08922	21997	00000	11078	70000	80000	333	10055	21																
2009-12-05	08	08922	21997	00000	11034	70000	80000	333	10054	21																
2009-12-05	08	08922	21997	20000	10025	70000	80007	333	10095	21																
2009-12-05	08	08922	21997	30000	10060	70000	80002	333	10110	21																
2009-12-05	08	08922	21997	00000	11030	70000	80000	333	10115	21																
2009-12-05	08	08922	21997	10000	11048	70000	80002	333	10100	21																
2009-12-05	08	08922	21997	50000	11066	70000	80007	333	10072	21																
2009-12-05	08	08922	21297	30000	11064	70000	83600	333	10068	21																
2009-12-05	08	08922	21697	40000	11074	70000	84600	333	10030	21																
2009-12-05	08	08922	21997	20000	11102	70077	80007	333	11051	21																
2009-12-05	08	08922	21293	80000	10008	76976	88677	333	10031	21																
2009-12-05	08	08922	21997	70000	11018	70000	87010	333	10068	21																

RESUMEN DE DATOS DE LA ESTACION PANTICOSA "REF. CASA PIEDRA" < 08922 >, AÑO 2

TEMPERATURA DEL AIRE (°C).

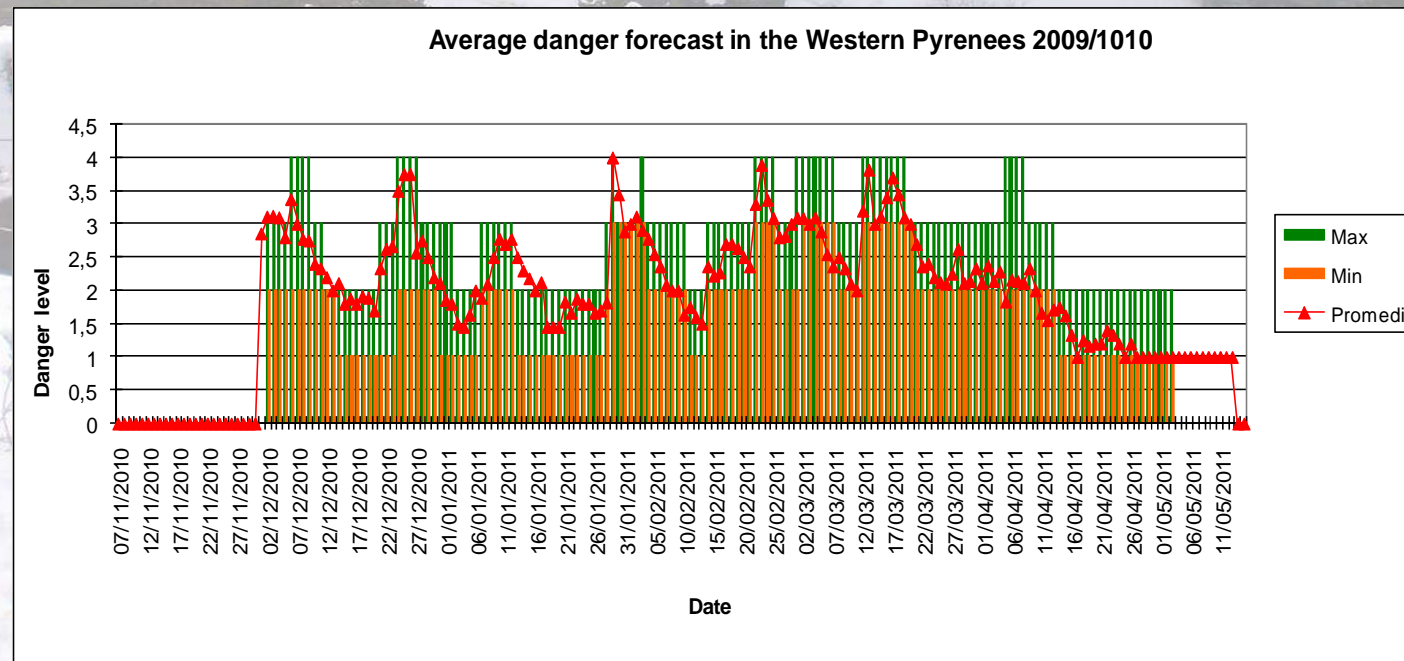
Command: Keys: f1←→ PgUp PgDn Q=next X=exit ?=Help



## OBSERVATION DATA

### 2. Checking of the danger levels issued in the last season and the current one.

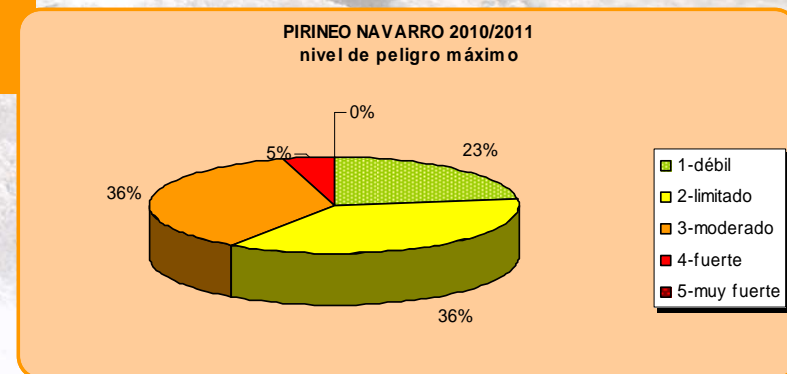
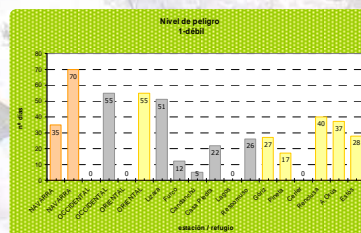
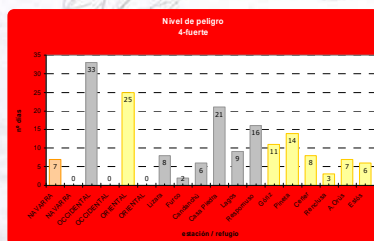
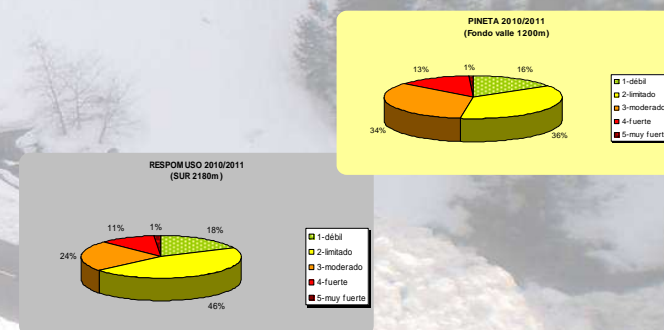
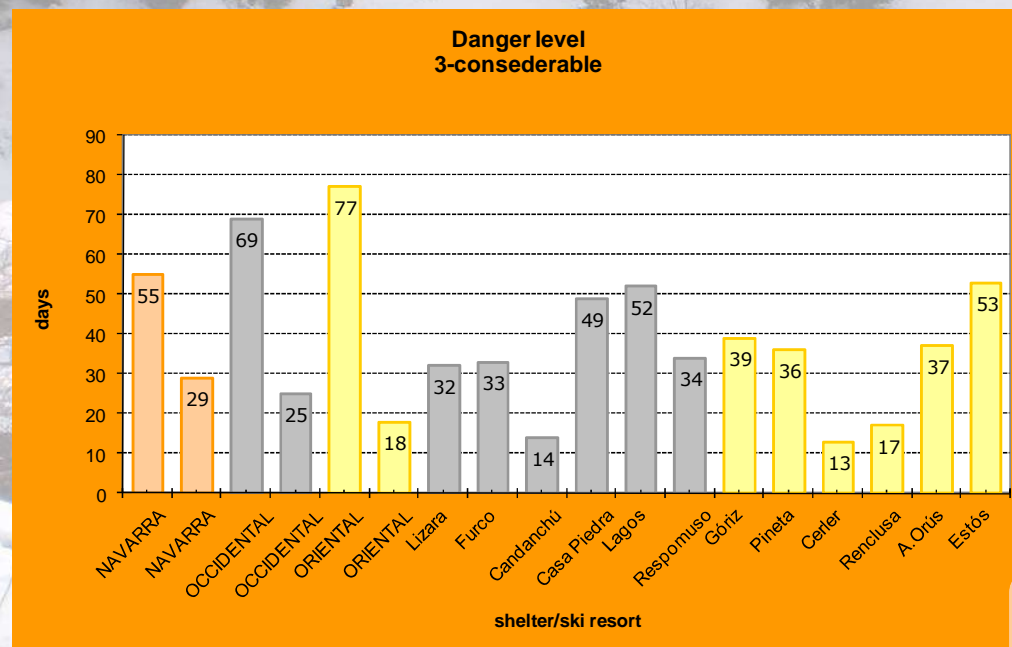
- Checking of the concordance between issued danger levels and observed danger levels.
- Tool for valuing the importance of problems like feedback between guides and avalanche forecasters or overpredictions. (some cases detected in previous seasons)





## DATOS DE OBSERVACIÓN

- Statistics of observed danger levels.



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# THANK YOU FOR YOUR ATTENTION

Photos: internal source

Bibliography pics: *"3x3 Avalanchas. La gestión del riesgo en los deportes de invierno"* – Werner Munter, Desnivel Ediciones  
*¡Avalancha!* – Robert Bolognesi, Desnivel Ediciones  
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